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Case Report

Unilateral Absence of Plantaris Muscle - Case Report

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ABSTRACT

Background - Unilateral absence of plantaris muscle.
Case report - During a routine dissection of lower limb on a female cadaver (age 89 yrs), it was observed that the plantaris muscle of the left lower limb was absent. Although the soleus and gastrocnemius muscle were normal, no attachment of plantaris muscle was identified at its origin or insertion. However, the plantaris muscle was observed on the right side, normal in origin, insertion, position and shape.
Discussion - Plantaris muscle originates from the lower part of lateral supracondylar line and the oblique popliteal ligament and gets inserted on to the calcaneus just medial to Achille's tendon via a long slender tendon. Variation in this muscle is very common; it may be sometimes absent (approx. 10% cases) or it may be double.
Conclusion - Despite its vestigial nature, documentation of anatomical variation of plantaris muscle is clinically important. Anatomical variations and injuries of the plantaris muscle can contribute to understanding of etiology of cases of knee pain (Patellofemoral pain syndrome) or leg pain (tennis leg), complicate surgery while resembling a nerve, and may serve as useful tendon grafts despite debates regarding its potential role in proprioception and knee stability. Imaging is important to diagnose isolated injuries and exclude serious conditions like DVT

Keywords*: Plantaris Muscle, Tendo Calcaneus, Freshman's Nerve, Patellofemoral Pain, Tennis leg, Radiologists*

INTRODUCTION

Plantaris muscle arises from the lower part of the lateral supracondylar line and the oblique popliteal ligament.[1] The plantaris muscle is classified as a flexor group of leg muscles.[2] Other than primates, the plantaris is the biggest muscle among animals.[3] It runs parallel to the gastrosoleus complex, then along the medial side of the Achilles tendon[4](AT) before inserting into the greater tuberosity of the calcaneus.[5] Its fusiform belly, which is 7-10 cm long,[6] ends in a long, thin tendon that attaches to the calcaneus just medial to the calcaneal tendon and travels distally along the medial border of the calcaneal tendon, passing obliquely and inferomedially between the gastrocnemius and soleus, and occasionally fuses with the calcaneal tendon at the end.[7] It is innervated by the tibial nerve (S1, S2).[6] Plantaris acts as a weak plantarflexor the ankle joint and flexor of the knee joint.[7] Additionally, the plantaris may give the central nervous system proprioceptive feedback about the foot's position.[8]

Plantaris muscle has been observed to present frequent variations in terms of its occurrence, origin, course, relation with surrounding neurovascular structures and insertion.[9] It is also reported that the muscle merges with the flexor retinaculum or the leg's superficial fascia.[10] It may be absent in 10% of cases.[11]

On rare occasions, its unilateral[11] and bilateral[12] double presences have been documented. The plantaris tendon makes an excellent graft.[13] One of the vestigial muscles,[9] the plantaris is sometimes confused with a nerve by first-year medical students, earning it the nickname "**freshman nerve**."[14] Its motor function is so minimal that its long tendon can readily be harvested for reconstruction elsewhere with little functional deficit.[15] Despite its vestigial nature, radiologists and clinicians may find it difficult to diagnose injuries to the plantaris muscle.[10] The muscle's surgical importance is based on the successful use of its tendon in reconstructive surgery.[16] Therefore, physiotherapists, plastic surgeons performing tendon transfer procedures, clinicians diagnosing muscle tears,[3] and radiologists interpreting MRI scans need to understand the anatomical variations of the plantaris muscle.[17]

CASE REPORT

The plantaris muscle was found to be absent in the left lower limb of an 89-year-old female cadaver during routine dissection in the Department of Anatomy, B.P.S GMC (W), Khanpur Kalan, Sonipat, Haryana, INDIA.

The dissection was performed in the posterior area of the leg and in the popliteal fossa. The skin and the superficial fascia were dissected, and the small saphenous vein and sural nerve were exposed. The popliteal fascia was then removed and the popliteal fossa was cleaned.

In addition, cleaning of the lateral and medial head of the gastrocnemius muscle was performed.
To expose the soleus muscle, the medial head of the gastrocnemius was cut, and turn the medial head laterally. Although the soleus muscle and gastrocnemius muscle were normal, no attachment of the plantaris muscle was identified at the origin or insertion. There was no evidence of union of the gastrocnemius or the soleus muscle with the plantaris muscle.
On the contrary, when the right lower limb was dissected, the plantaris muscle and its tendon were observed, normal in its origin and insertion, position and shape. Its fusiform belly was found to be 8.5cm long, ending in a long, thin tendon that attached to the calcaneus just medial to the calcaneal tendon.

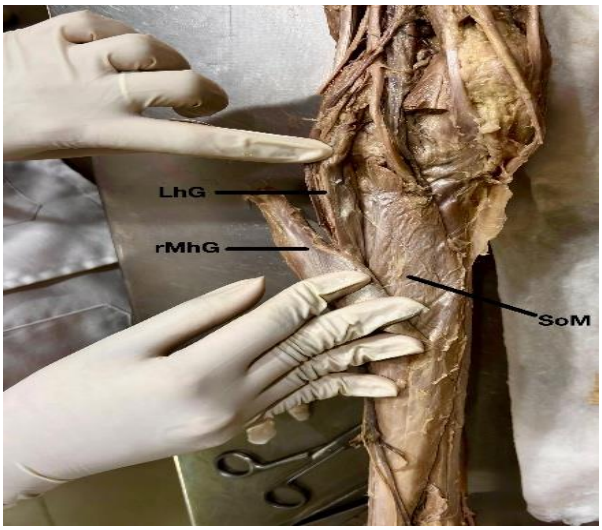

Figure. 1: Left lower limb with no attachment of the plantaris muscle was identified at the origin.
(LhG - Lateral head of gastrocnemius muscle, **SoM -** Soleus muscle
rMhG - reflected medial head of gastrocnemius muscle**)**

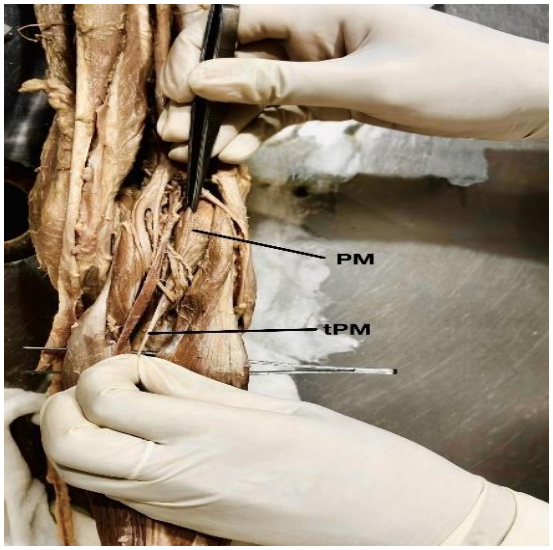

Figure. 2a: Right lower limb

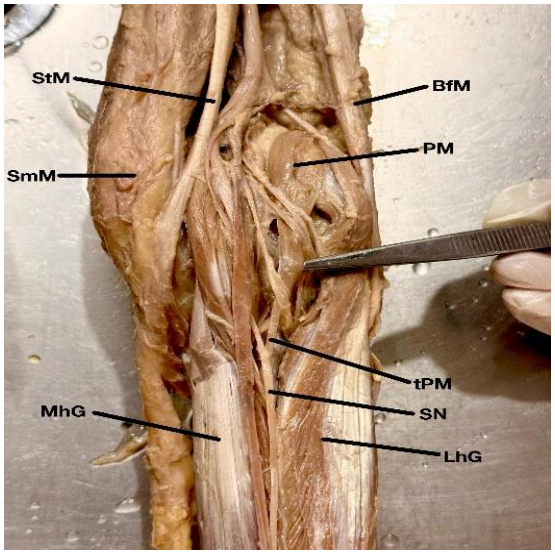

Figure. 2a: Right lower limb
(Plantaris muscle and its tendon were observed)
Figure. 2a & b: PM - Plantaris muscle, **tPM -** tendon of plantaris muscle, **StM –** Semitendinosus muscle, **SmM -** Semimembranosus muscle, **BfM-** Biceps femoris muscle, **SN -** Sural nerve, **LhG -** Lateral head of gastrocnemius muscle, **MhG -** Medial head of gastrocnemius muscle

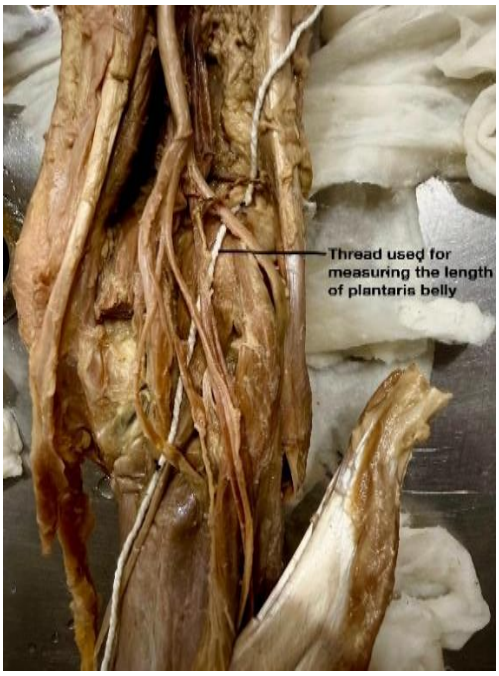

Figure. 3a: Right lower limb
(In this thread used for measuring the length of plantaris muscle belly.)

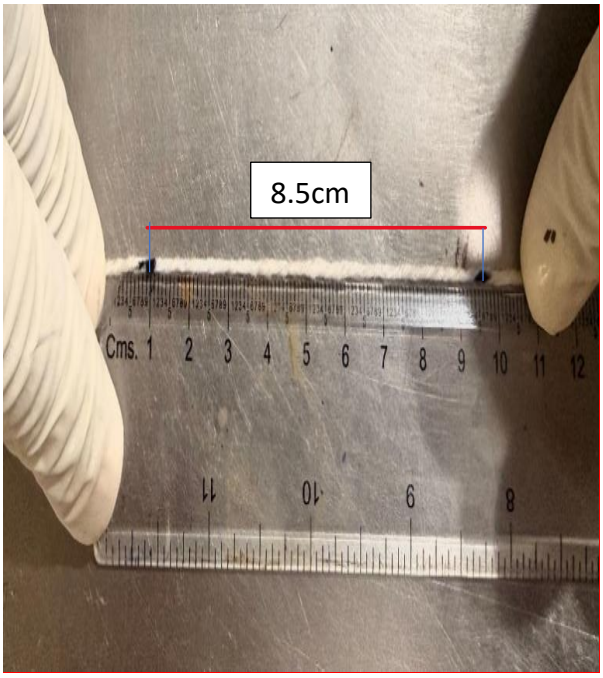

Figure. 3b:
(Fusiform belly was found to be 8.5cm long)

DISCUSSION

In 1893, Robert Wiedersheim published a book on human anatomy and its importance to man's evolutionary history.[1] This book contained a list of 86 human organs that he termed vestigial or as Wiedersheim himself described that the organs having become wholly or in part functionless, some occurring in the embryo alone, others present during life constantly or inconstantly.[9] Vestigial muscles in humans are distinguished by their small size, tendinous structure, and significant heterogeneity in frequency among populations.[7] The plantaris muscle is known for its variations.[11] Standard textbook of anatomy has reported the fact, that the muscle may be sometimes absent[4] or it may be double.[3] Plantaris muscle is known as vestigial muscle in human as its distal attachment has shifted secondarily well short of plantar aponeurosis to calcaneus due to process of evolution for erect posture[1] and bipedal locomotion.[13] Embryologically, it is considered as a derivative of deeper portion of lateral head of gastrocnemius and often represented as third head of gastrocnemius[14] or 'gastrocnemius tertius'.[12] In this case, the observation of connective fibres between the lateral head of the plantaris muscle and the lateral head of the gastrocnemius muscle supports McMurrich's embryological explanations, suggesting a shared developmental origin.[7]

Plantaris muscle originates from the lower part of lateral supracondylar line and the oblique popliteal ligament[6] and gets inserted on to the calcaneus just medial to Achille's tendon via a long slender tendon.[8] Variations in terms of its distinct interdigitations with lateral head of gastrocnemius[3] or having a strong fibrous extension to patella may be responsible for **patellofemoral pain syndrome**.[17] The fusiform belly of the muscle has a long slender tendon which may be mistaken as a nerve.[10] Often, the tendon of the plantaris muscle fuses superficially with the fascia of the leg, thereby making it vulnerable to injury.[3] Topographical anatomy of the plantaris muscle is important for any surgery.[1] Prior knowledge of superficial position of the tendon and its resemblance to a nerve should be borne in mind by any surgeon operating on the back of leg.[10] Despite its small size, injuries of the plantaris muscle and tendon, which have been termed "**tennis leg**,"[5] have been a source of controversy in the literature. Tennis leg is a reasonably common clinical ailment.[15] It has previously been attributed to a variety of causes, including plantaris tears,[3] medial head of gastrocnemius tears, soleus tears, or a combination of these.[10] The injury happens most frequently during running or jumping, and is primarily caused by an eccentric load imposed across the ankle with the knee fully extended.[1] The rupture of the plantaris muscle tendon is frequently difficult to identify, and one crucial finding is the existence of a tense mass between the gastrocnemius and soleus muscles.[3] The plantaris muscle has proven to be an excellent graft.[16]

Studies have documented the anatomical process of reconstructing the anterior talofibular and calcaneofibular ligaments with a free plantaris tendon graft.[4,13] It has also been tried for atrioventricular valve repair.[16] In the existence of additional flexors like gastrocnemius and soleus muscles, the removal of plantaris muscle may not have an effect on the normal limb function.[10] In the absence of the plantaris muscle, the primary stable knee ligaments may be more prone to damage, through increased relaxation of the knee during lateral and medial rotation, and weakened, and early knee flexion, and this information is instrumental for orthopedicians.[2,5] The plantaris muscle tendon is a highly tensile[3] structure that has been effectively employed for flexor tendon replacement in the hand.[15]

Given the data shown above, the significance of the plantaris muscle cannot be overstated.[3] Magnetic resonance imaging, sonography, and surgical exploration have now shown that damage to this muscle can develop in isolation.[14] Magnetic resonance imaging and ultrasonography[7] have been the principal imaging tools for evaluating individuals with nonspecific posterior lower leg discomfort.[9] The purpose of imaging patients with this illness is to rule out more dangerous conditions such as deep venous thrombosis.[13] Physiotherapists, plastic surgeons performing tendon transfer surgeries, doctors diagnosing muscle rips,[10] and radiologists interpreting MRI images[1] all need to be aware of the anatomical variances of the plantaris muscle.[2]

CONCLUSION

The plantaris muscle's absence in this cadaver is academically notable. Recognizing its variations is crucial for surgeons, clinicians, and radiologists to prevent surgical injuries and improve diagnosis. Understanding the plantaris tendon's anatomy benefits tendon transfer procedures, muscle tear diagnoses, and MRI interpretations. Its significance is substantial, impacting surgical and diagnostic accuracy. Awareness of plantaris variations is essential for effective medical practice.

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